we used self-reported questionnaires and a set of performance-based objective tests to investigate associations between the two constructs, in ACL-reconstructed patients, a population known to be at high risk of developing osteoarthritis.

Aim: To investigate the extent to which an objective test-battery of 4 separate tests of functional and/or muscle performance are associated with Knee osteoarthritis outcome score (KOOS) subscale scores Sport/Recreation (Sport/Rec) and Quality of life (QOL)) in ACL-reconstructed patients, with the perspective of specifying future areas of intervention, that potentially may facilitate rehabilitation in this patient population.

Methods: This cross sectional study was performed in 23 ACL-reconstructed men (mean age: 27.2 ± 7.5 years and BMI: 25.4 ± 3.2) 18-30 month post-surgery. KOOS-questionnaires were completed and subsequently, all patients performed a test-battery composed of: (i) one-leg maximal jump for distance (OLJD), isometric maximal voluntary contraction (MVC) strength for (ii) knee extensors and (iii) knee flexors, and (iv) unilateral maximal counter movement jump (CMJ). Sagittal kinematic data was synchronously recorded during CMJ using a 6-camera Vicon MX system. KOOS Sport/Rec and QOL were *a priori* defined as the depended variables. Furthermore, we defined 4 models of non-depended variables to be tested using outcomes from the 4 separate tests (Table 1). Multilevel regression analysis was used to determine coefficient of determinations for the 4 defined models.

Results: Moderate associations between OLJD and Sport/Rec ($r^{\ddagger} = 0.26$, $p < 0.01$) and QOL ($r^{\ddagger} = 0.26$, $p < 0.01$) were observed (Model 1; Table 1). Adding either knee extensor or flexor MVC to the analysis (Model 2a,b) increased the strength of the associations (up to $r^{\ddagger} = 0.53$, $p < 0.01$, and $r^{\ddagger} = 0.31$, $p = 0.02$ for Sport/Rec and QOL, respectively). Adding both knee extensor and knee flexor MVC strength to the analysis (Model 3) did not improve the regression model. Minor increases in regression strength were observed when including kinematic data from the motion analysis of CMJ (Model 4a,b,c) (up to $r^{\ddagger} = 0.55$, $p < 0.001$, and $r^{\ddagger} = 0.40$, $p = 0.04$ for Sport/Rec and QOL, respectively).

Conclusions: A large proportion (31–53%) of the variation in KOOS (Sport/Rec and QOL) was explained by OLJD and knee extensor-flexor strength. Adding CMJ kinematics to the model had only minor additional impact. Thus, the present findings suggest that ACL-patients should be evaluated using both functional performance (OLJD) and lower limb muscle strength testing. This may add to our understanding on how to effectively design future rehabilitation interventions for this patient population, at high risk of osteoarthritis. To examine if patients' self-perceived function and quality of life can be improved by enhancing physical function and muscle strength, more research should be directed towards understanding the association between objective measures and self-reported outcomes.

Table 1
Associations between KOOS and objective outcomes organized in 4 models

	Sport/Rec		QOL	
	$R^{\ddagger}$	P	$R^{\ddagger}$	P
Model 1	0.256	0.012	0.259	0.011
Model 2a	0.516	0.001	0.311	0.020
Model 2b	0.366	0.008	0.311	0.020
Model 3	0.527	0.002	0.330	0.042
Model 4a	0.550	0.003	0.371	0.056
Model 4b	0.529	0.005	0.403	0.036
Model 4c	0.538	0.004	0.332	0.090

Model 1: One Leg Jump for distance (OLJD) vs. Knee Osteoarthritis Outcome Score (KOOS)
Model 2a: OLJD + extensor isometric maximal voluntary contraction (MVC) vs. KOOS
Model 2b: OLJD + flexor MVC vs. KOOS
Model 3: OLJD + extensor MVC + flexor MVC vs. KOOS
Model 4a: OLJD + extensor MVC + flexor MVC + Counter movement jump (CMJ) Jump height vs. KOOS
Model 4b: OLJD + extensor MVC + flexor MVC + CMJ knee range of motion vs. KOOS
Model 4c: OLJD + extensor MVC + flexor MVC + CMJ deepest knee angle vs. KOOS

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INCREASED MEDIALLY ORIENTED GROUND REACTION FORCE DURING GAIT IN PATIENTS WITH VARUS KNEE OSTEOARTHRITIS CAN BE TREAT TARGET TO REDUCE MEDIAL COMPARTMENT LOADS

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Purpose: Knee adduction moment (KAM) during gait is known to indicate disease severity and prognosis of varus knee osteoarthritis (OA) [Baluinas 2002, Hurwitz 2002]. Thus, to reduce KAM is a key strategy in treatment of knee OA. KAM is primarily calculated as the product of the resultant ground reaction force (GRF) in the frontal plane and the perpendicular distance from the GRF to the knee joint center (frontal plane lever arm). The GRF and frontal plane lever arm are independent variables and modification of either variable can alter the KAM. Associations between peak KAM and peak frontal plane lever arm, and static alignment in coronal plane (femorotibial angle: FTA) in OA knees have been reported [Hunt 2006, Hurwitz 2002]. However, correlation between KAM and dynamic parameters during gait, such as toe-out angle, is still controversial [Shull 2013]. Purpose of the study was to indicate dynamic index which affects KAM during gait, and to propose possible treat target to reduce KAM in varus OA knees.

Methods: Gait analysis was performed on 56 knees of 43 patients (all female) who had varus knee OA of K-L grade 3 (6 knees) and grade 4 (50 knees), and 12 knees of 12 healthy subjects to obtain baseline data. The subject information is summarized in Table 1. After approval of IRB for this study and the informed consent, the subjects were tested at gait laboratory, using an opto-electronic motion capture system (Pro-reflex, Qualysis, Sweden) and a force plate (AM6110, Bertec, USA) at synchronized frequency of 120 Hz. Total of 6 skin makers were placed on the subjects on each segment of the lower limb and iliac crest. All the subjects performed level walking on a 10 m walk-way with their comfortable walking speed. KAM was calculated using an inverse dynamics approach and normalize to percent bodyweight times height (%BW × Ht), and GRF was normalized to percent bodyweight (%BW). Two components of GRF (medial: perpendicular to progression of gait and medially oriented, and vertical: vertical to anterior-posterior and medial-lateral axis) were analyzed. GRF frontal plane lever arm was defined as the distance between knee joint center and maximum ground reaction force vector during stance phase of gait. KAM and gait parameters (toe-out angle, medial and vertical GRF, frontal plane lever arm) were statistically compared between OA and healthy groups using student T-test. Correlation between KAM and limb alignment (FTA in standing radiography), and the gait parameters were statistically evaluated in patients group by Pearson's regression analysis. Correlation coefficients and significance levels were indicated in the text. Results: Overall, KAM, medial and vertical GRF, and frontal plane lever arm of the OA group were statistically greater than those in healthy group, but there was no difference in toe-out angle between these two groups (Table 1). In OA knees, KAM was significantly correlated with FTA and medial GRF but not with toe-out angle and vertical GRF (Figures 1-3, Table 2). In addition, medial GRF was significantly correlated with frontal plane lever arm ($R = 0.38$, $P = 0.04$) but not with FTA ($R = 0.22$, $P = 0.1$).

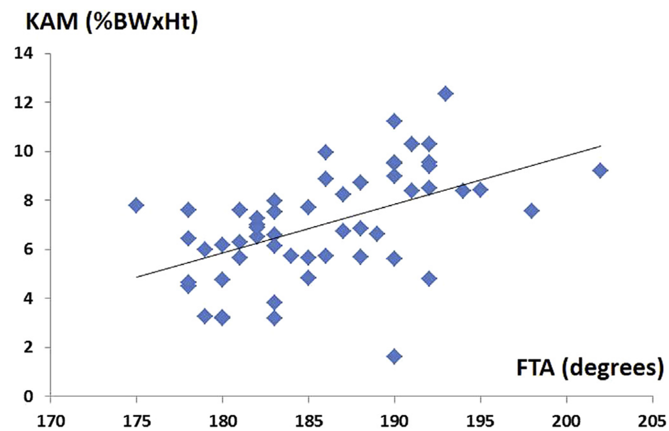
Discussion & Conclusions: Although this cohort includes more severe OA knees than past studies [Baluinas2002, Hurwitz 2002, Hunt 2006], our results agree with those studies that KAM closely correlates with FTA and frontal plane lever arm. This fact suggests that static and dynamic limb alignment on the coronal plane is primary factor to determine KAM during gait, and explains validity to correct coronal plane limb alignment by surgeries such as high tibial osteotomy or total knee arthroplasty. Both medial and vertical GRF were increased in OA knees, however only medial GRF correlated with KAM (Figures 1-3 and Table 2). Also, toe-out angles in OA group did not show any correlation with KAM or other gait parameters (data not shown). Thus, increased medial GRF is thought to be a secondary factor to increase KAM. The results indicate that modification of gait pattern to reduce medial GRF by non-surgical interventions (insoles, gait training, etc) may be effective to reduce KAM and medial compartment loads, but effect of changing toe-out angle remains unclear.

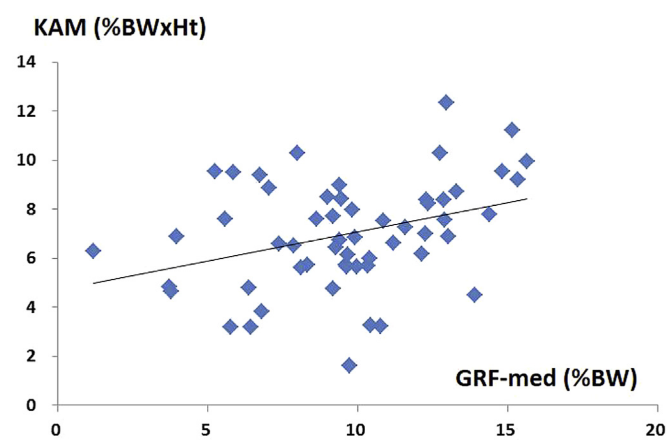
Subject summary (*P < 0.05, Student T-test)

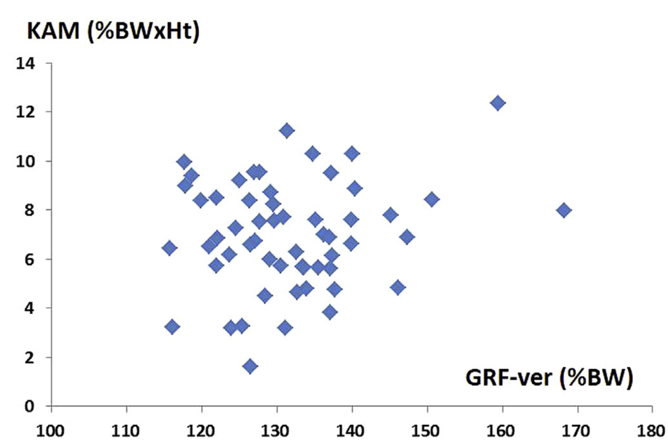
	Subjects (M:F)	Knees	Age (ragne)	FTA (deg) (range)	Knee Score (range)	KAM (%BW × Ht)	Toe-out angle (deg)	GRF-med (%BW)	GRF-ver (%BW)	Frontal lever arm (mm)
OA	43 (0:43)	56	73 (57-86)	185.8 (175-202)	52.2 (22-90)	7.0 ± 2.2*	9.9 ± 8.0	9.7 ± 3.2*	131.8 ± 10.1*	8.0 ± 2.1*
Control	12 (2:10)	12	63 (60-82)	-	-	3.1 ± 1.0	15.2 ± 6.1	4.8 ± 4.1	104.7 ± 12.5	4.7 ± 1.5

Correlation between KAM and variables

	FTA	Toe-out angle	GRF-med	GRF-ver	Frontal lever arm
R	0.51	0.001	0.35	0.16	0.861
P value	< 0.001	0.99	0.008	0.23	< 0.001







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DEVIATIONS IN GAIT METRICS IN PATIENTS WITH CHRONIC ANKLE INSTABILITY

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Purpose: Gait metric alterations have been reported in patients suffering from chronic ankle instability (CAI). Those studies comprised relatively small cohorts and their findings were inconsistent. This study was undertaken to examine spatiotemporal gait parameters in patients with CAI and examine the relationship between self-reported disease severity and the magnitude of gait abnormalities.
Methods: Medical files of all patients diagnosed as having CAI and referred to a private treatment center between May 2009 and February 2012 were retrieved from the center's database and evaluated. Inclusion criteria were the reporting of recurrent ankle sprains, instability, and a tendency of the ankle to "give way" during sports activities for the past ≥6 months. Age and gender-matched healthy people served as controls. All participants underwent a spatiotemporal gait analysis on a computerized mat and completed the Short Form (SF)-36 health survey.
Results: Of the 95 eligible patients, 44 fulfilled study entry criteria and were compared to 53 controls. The CAI patients' walking velocity was ~16% slower, their cadence was ~9% lower, and their step length was ~7% shorter than the controls. Their base of support during walking was ~43% wider and their single limb support was ~12% shorter than the controls. Their SF-36 Pain and Physical Function subscales were significantly lower compared to controls (P < 0.05).
Conclusions: These results form a gait profile for patients with CAI. Significant differences with controls were found in most tested spatiotemporal gait parameters, most importantly in the base of support. These gait alterations may reflect strategies for coping with imbalance and pain. Measurements of gait parameters in combination with self-evaluation questionnaires are highly useful for assessing disease severity and for follow-up of individuals diagnosed as having CAI.

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A COMPARISON OF KNEE JOINT BIOMECHANICS DURING FREE GAIT AND CARTILAGE T2 MAPPING VALUES IN HEALTHY INDIVIDUALS IN THEIR TWENTIES AND FORTIES

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Purpose: The aim of the study is to investigate the difference in knee joint kinematics and kinetics during gait, and T2 mapping values in a healthy female population between their twenties and forties in order to obtain the knee motion changes related to early knee OA change.
Methods: Thirty healthy women, 15 in their 20s and 15 in their 40s participated. A 3-D motion analysis system (Venus 3D; Nobby Tech) with a 10-camera and a force plate (Accugait; AMTI) was used to obtain knee joint kinematic and kinetic data. Twenty-five reflective markers (7 mm diameter) were attached at the bony landmarks and skin on the measurement side of the leg (Fig.1). Kinematics, segment masses and moments of inertia were used in standard inverse dynamics equations to calculate external knee joint moments normalized by body weight and leg length. The first and second peak values during the stance phase were used in the final analysis. The tasks were performed barefoot, and the right or left leg was chosen randomly. Subjects were asked to free walk (comfortable speed) along a 7-m walkway. The T2 measurements